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Grading in Interaction Design Education Using Design Practitioners' Conceptions of Process Quality

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Abstract. The designed product is often assessed in interaction design education, but there are also courses that focus on learning the design process. It is then necessary to develop criteria for grading in such courses. To make a successful transfer from theory to practice, students also need to learn the criteria practitioners use, rather than the criteria that academically oriented teachers use. To do this, one approach is to align criteria with the conceptions practicing interaction designers have of process quality in design. Therefore, the research questions for this study are what those conceptions are, and how they can be utilized in grading criteria for interaction design projects in education. Interviews were made with ten interaction designers. The interviews were qualitatively analyzed. The results demonstrate that practicing interaction designers conceptualize the quality of the design process in three ways: it is good if established methods are used and the design is managed within resource constraints, and within organizational and technological limitations, while also meeting stated objectives; it is even better if the design has a thought-through rationale; and ideally, the design should also be inspirational. These conceptions were transferred to points on a criteria-referenced grading scale which was used to develop course specific grading criteria. The criteria were evaluated in terms of comprehensibility and reliability. The evaluation showed that most of the students who also attended lectures understood the criteria. A high and significant covariation and a high level of agreement between the two teachers who graded the projects were shown. Further, the developed criteria should be generalizable to other process-centered interaction design courses and to assessment in other design disciplines.

Keywords: interaction design education, human-computer interaction education, design education, process quality in design, assessment, grading

1 Introduction

This paper concerns the grading and assessment of students' interaction design projects and the focus is on the process of design rather than the

product of design. Moggridge (2007), who was one of the pioneers in interaction design, pictured the field as a creative and imaginative design discipline working with software, designing behaviors, animations, sounds, and shapes. Like industrial design, the new design discipline would focus on qualitative values. It would start with the needs and desires of people who would use a product or service, and aim towards designs that would give aesthetic pleasure, lasting satisfaction and enjoyment. Interaction design does not only involve considering the interactions of people with the product, but also their interaction with the world and other people by means of the product (Arvola, 2006; Buchanan, 2001, Hernwall and Arvola, 2008).

The education of interaction designers is similar to that of product designers and architects, in that it often involves open-ended projects similar to real practice, critique sessions, and a public presentation of the work at the end of the project (Thomassen and Ozcan, 2010). The presentation often focuses on the products, but in many educational situations, design teachers would like to focus more on the process than on the product. One way to focus the design education on process rather than product is to ask students to keep a design log (i.e. sketchbook, idea log or design diary). The design log is a sequential visual record of their ideas and insights (Verplank and Kim, 1987). Teachers can review this to get an idea of the students' design process. A design log is about a clear and functional sketching of ideas in depth and breadth; it is not about fine art. Another approach is to ask the students to write a project report, which takes more time and is also constructed after the fact, and thus does not give a snapshot of the process. Both a log and a report can fill important roles in assessing the design process; but what criteria should be used when grading? According to the interaction design literature the answer would be the proper use of user-centered design methods described in commonly used textbooks (Cooper et al., 2007; Sharp et al., 2007; Benyon, 2010; Saffer, 2010). The literature would also point towards a clear presentation of the argument behind the design (MacLean et al., 1989), close cooperation with users (Schuler and Namioka, 1993), and a critical or reflective attitude to the design work (Gaver and Martin, 2000; Löwgren and Stolterman, 2005; Sengers et al., 2005).

Other sources may also give input to criteria to use when grading. For example, the ISO standard 9241—Ergonomics of Human Systems Interaction (International Organization for Standardization, 2010), defines principles and guidance for large parts of human-computer interaction (HCI), including defining human-centered design processes for interactive systems (Part 210), and user performance testing (Part 304). The ACM SIGCHI has also developed a curriculum for HCI (Hewett et al., 1996). It specifies courses and possible routes of progression through them depending on their context. Recently in the UK, efforts have been made to identify competency frameworks relevant to interaction design. These efforts include defining

competencies in design (Creative & Cultural Skills, 2009), interactive media (Skillset, 2009), and the IT professions (SFIA, 2011). RDCEO—The Reusable Definition of Competency or Educational Objective—is an international initiative to specify common understandings of competencies as learning pre-requisites and learning outcomes (IMS Global Learning Consortium, 2012). The SCQF—Scotland's Lifelong Learning Framework—defines qualifications on a twelve-level scale. It provides a vocabulary for describing learning, and is made to make it easier for learning providers to design and manage study programs, and for employers to manage competence development and recruitment (SCQF, 2010).

All these efforts are aimed at developing competency frameworks, defined in terms of skills or learning outcomes for the field, but they give little guidance on how to grade students' performance within a unit or a course. SCQF has a level system that could be used to develop assessment criteria on a grading scale, but it is not clear how the mapping beyond the passing grade should be constructed.

1.1 Assessment Criteria in Design Education

This paper describes the development of process-centered grading criteria for interaction design projects in a criterion-referenced grade system, which means that the student's performance is compared to a pre-defined standard as opposed to relative grades. This kind of grade system is used throughout Sweden. One approach to specifying the criteria for the different grades is to ground them in taxonomies, such as the SOLO taxonomy (Structure of the Observed Learning Outcome) (Biggs and Collis, 1982). Leung (2000, p. 157) adapted the criteria in that taxonomy to design education in the following way:

> [Pre-structural knowledge:] Display incompetence in design. Problem is not attempted or the key aspects are not clearly defined or solved. Fail to relate the ideas presented to the problem. Information produced does not benefit solving the problem.
>
> [Uni-structural knowledge:] Display limited design abilities. Problem is defined from a narrow perspective at a superficial level. One or a few aspects are picked up in designing. Some important aspects are missing in the design ideas. Although not many aspects of exploration and judgment are observed, they can lead to weak or simple solutions to solve problem with minimum quality.
>
> [Multi-structural knowledge:] Display comprehensive design abilities, but in isolation. Problem is defined from wide perspectives with many design ideas generated. Essential and important aspects are picked up in designing. Many elements of exploration and judgment are observed. However, the design ideas are loosely organized, with different ideas not integrated coherently. Some design features misfit another, and judgments are not consistent.

> [Relational knowledge:] Able to relate different design skills to form coherent analysis, statements, design ideas and judgments. Answers are not only a sound design proposal to the problem, they are presented in a coherent and structured way. Explanation of why and how the solution is developed, realized in practical terms, and evaluation judgments on how far the solutions satisfy the original needs and specifications, are components."
>
> [Extended abstract knowledge:] Display higher modes of operation in structuring knowledge to solve a problem. In addition to what can be observed at the relational level, some new and creative ideas through logical and mature design developments are presented.

Leung's application of SOLO to design education combines assessment of the product with assessment of the process. The focus for the current paper is assessment of the design process. Leung's criteria are also based on design teachers' ideas of design quality, and students adapt their activities to the grading criteria determined by the teacher. However learning the values teachers hold will not necessarily facilitate the students' transfer to professional practice. They also need to incorporate the values shared among practitioners. One approach for this is to account for design practitioners' conceptions of process quality in the assessment criteria. This does not, however, mean that academic criteria are obsolete.

1.2 Research Questions

The study starts from the research questions of what ideas practicing interaction designers have of design process quality, and how they can be utilized in grading criteria for interaction design projects in education.

Ideas that practicing interaction designers have will be analyzed in this paper using the theoretical construct of 'conceptions'. A conception is a specific way "in which people understand a particular phenomenon or aspect of the world around them" (Marton and Pong, 2005, p. 335). The research presented here focuses on the specific ways in which interaction designers understand process quality in design, and how to integrate those ways of understanding into assessment criteria for student design projects. Conceptions are represented by qualitatively different meanings or 'categories of description' of the phenomenon.

For assessment criteria used in grading, inter-marker reliability (i.e. that different teachers assign the same grade to projects) is important for a basic validation. It must be established that more than one examiner can use the criteria as a measurement tool and reach similar results. Students also need to feel that they understand the criteria used in a course in order to get a sense of control. The subsequent research questions are: whether the criteria that have been developed have inter-marker reliability, and if students can understand them.

2 Material and Methods

The method used in the study has two elements. Firstly, an interview study was conducted to clarify what conceptions interaction designers have of quality of the design process. Secondly, conceptions identified were developed into course specific criteria that were evaluated in terms of understandability and inter-marker reliability.

2.1 Interview Study

The focus for the interview study was on the range of experiences of design process quality among practicing interaction designers and aimed at analytically deriving categories of description and clarifying the relations between categories. Semi-structured interviews were conducted with ten professional interaction designers. Interviews were recorded and transcribed into a verbatim transcript, which was analyzed using qualitative content analysis.

2.1.1 Participants

Ten interaction designers (four female and six male), with four to thirteen years' work experience, participated in the study. Two participants lived in Finland and eight lived in Sweden. The designers in Sweden had an educational background in cognitive science with a focus on interaction design. One of the designers in Finland was originally from Spain, but had lived in Finland for eleven years. He had an educational background in business and new media with a design focus. The other designer in Finland described himself as a media artist and designer, and had an educational background in photography and installation art. He was self-taught in new media.

The different projects that the participants brought to the interviews covered government websites, intranets, office applications, electronic medical records software, air traffic management software, concept design for future home communication applications, ambient media embedded in architectural space and furniture, interactive exhibitions for trade shows, and mobile television applications.

Participants worked as freelance designers, at small-sized usability and design consultancies, and as in-house designers at software companies.

2.1.2 Data Collection

The interviews were semi-structured and followed a list of interview questions, while also allowing for new questions to be brought up as the

interview progressed. The ten interviews ranged from 45 minutes to 1 hour 40 minutes. Five of the interviews were conducted face to face and five were conducted using a software application for video calls via the Internet. Three interviews were audio recorded and seven interviews were also video recorded. Pictures such as sketches, presentations and screen dumps were gathered from the participants for further analysis.

The two interviews conducted in Finland were made by one interviewer in English, and another interviewer later carried out the interviews in Sweden in Swedish. The exact wording in the interview guide was revised after the first two interviews. The interview guide covered the following areas:

- The workplace
- Projects
- Professional role
- Professional and educational background
- Conceptions of design quality
- Design process

Perceptions related to the quality of the design process in the participants' design projects were evoked by asking questions like: 'What design work do you wish to show here?' and 'What was really good and what was less good about this project?' To confirm that participants not only repeated the buzzwords of their education or organization, they were also asked to elaborate on differences between their perspective on quality and other perspectives in their organization or educational background.

All taped material from the interviews was transcribed and partly normalized to a written form, rather than to a verbatim, spoken language form. When an interview had been transcribed, it was sent to a participant so that he or she could remove things that he or she did not want to include in the interview (e.g. names of clients).

2.1.3 Procedure of Analysis

The method for analysis built on Graneheim and Lundman's (2004) review of the methodological literature on qualitative content analysis. The interviews were read and listened through several times to obtain a sense of the whole. The text about the participants' perceptions regarding process quality in their design project was extracted from the transcription and brought together into one text. The extracted text was divided into meaning units that were subsequently condensed. The condensed meaning units were abstracted and labeled with a code.

The various codes were compared based on differences and similarities, and then sorted into categories and sub-categories which constituted the

manifest content. The tentative categories were discussed by a group of researchers and revised. The group of researchers (with a background in HCI and design research) had not participated in the interviews and were not otherwise involved in the project. What varied among the researchers were judgments about sub-categories, and the wording of specific codes and categories. Reflection and discussion resulted in agreement about how to sort the codes. The underlying meaning, that is, the latent content of the categories was formulated into themes. Finally, the relations among categories of description were analyzed in more detail.

The categories and their relations were subsequently reformulated into general grading criteria for use in interaction design education (see Section 4.4 for further details).

2.2 Evaluation of Course Specific Criteria

To make use of the general grading criteria in a specific course, it is necessary to adapt them to the desired learning outcomes for the course. This was tested in an interaction design course for second year students on a three-year graphic design and communication bachelor's study program.

When testing new pedagogical ideas in practice with students, a few ethical considerations need to be made. First and foremost, it is important that the students would benefit from more clear grading criteria. Earlier students on this course had often experienced them as unclear. We also followed the ethical requirements from the Swedish Research Council (Vetenskapsrådet): the information requirement, the consent requirement, the confidentiality requirement, and the usage requirement. This means that the students were informed that the grading criteria were based on research with professional designers, and that they were being tested in this course for the purpose of further clarifying the grading criteria. The students were not required to fill in questionnaires or participate in discussions about the criteria if they did not want to, and all the questionnaires were anonymous. Students were informed that there were no negative consequences of choosing not to participate. They were also informed that all data gathered would be used only for research and pedagogical development. The content of the information gathered was about the grading criteria used in the course, and accordingly not of a private nature. Consent was given when the student answered the questionnaires. Consent was not considered necessary with regard to data gathered from public records. The requirement for confidentiality was not an issue since no information of a private nature was collected, and it was not possible to identify individual participants on the basis of the data gathered. Finally, with regard to the usage requirement, data gathered from individuals was not used for commercial purposes, and it was not used in a way that affected individual participants.

The only ethical concern experienced was that the students were, in a sense, dependent on the researcher, who also was the examiner and a lecturer for the course. It is therefore possible that some may have experienced pressure to participate. It was, however, stressed on several occasions that participation was completely voluntary, and it was impossible for the researcher/teacher to identify the contributions from individual students, except during class discussions.

The adaptation of the general grading criteria to the specific course mainly involved identifying what methods the students were intended to use and learn during the course. Another adaptation was that we tried to specify how the students could show that they met a criterion. Special attention was also given to using a language that the students could understand and relate to, based on their background. We also introduced some criteria for learning objectives that were not related to the design process.

Students' understanding of the course specific criteria was evaluated with the students during the course, and inter-marker reliability was evaluated after the course.

2.2.1 Comprehension

The comprehensibility of course specific criteria was measured in a questionnaire handed out to the students during a lecture. All grading criteria were evaluated on an ordinal scale from 1 to 4. The instruction to the students was to circle one answer for each criterion that best fit how well the student understood the criterion:

1 = I do not understand the criterion at all
2 = I do not understand the criterion very well
3 = I understand the criterion quite well
4 = I understand the criterion very well

The response rate was 60% (n = 38, total number of students = 63).

2.2.2 Reliability

An inter-marker reliability analysis was made using Spearman Rank Order Correlation (rho) to determine the covariation between the two teachers who independently marked the students' reports.

Whether or not the correlation was significant was also tested. It is sometimes argued that it is not necessary to test for significance when analyzing inter-marker reliability (Neuendorf, 2002), but without such a test it would not be possible to know if there actually is a correlation beyond chance

or not. Only then can it be established whether the correlation is weak or strong (Borg & Westerlund, 2006).

The correlation ranges from -1.00 (perfect disagreement) to .00 (disagreement) to 1.00 (perfect agreement). Cohen (1988; in Borg and Westerlund, 2006) considered a correlation of .10 as weak and a correlation of .50 strong. This applies to Pearson's Product-Moment Correlation, and accordingly also to the Spearman Rank Order Correlation, since it builds on the same principle.

The level of agreement is reported using Cohen's kappa, for which the following criteria has been suggested: .75+ for excellent agreement beyond chance; .40 to .75 for fair to good agreement beyond chance; and finally below .40 for poor agreement. Kappa is usually not tested for significance (Neuendorf, 2002).

3 Theory

The focus for the interview study relates to conceptions that practicing interaction designers have of process quality in design. Conceptions include both structural and referential aspects of experience (Marton and Booth, 1997). Structural aspects refer to the discernment of the whole from the context and discernment of the parts and their relationships within the whole. Referential aspects refer to the identification of what something is, i.e. the assignment of meaning. Conceptions relate to each other in a structure, but the conceptions in themselves also have referential aspects and an internal structure (Marton and Pong, 2005). This means that the referential and structural aspects of a phenomenon form a hierarchy of experience where a person's focus of awareness can move between the details and the whole. Marton and Booth (1997, pp. 86-87) give an example to explain what is meant by these concepts. Imagine the experience of walking through the woods at night and seeing a motionless deer among the dark trees and bushes:

> To see it at all we have to discern it from the surrounding trees and bushes; we have to see its contours, its outline, the limits that distinguish it from what surrounds it. We have to see, at least partially, where it starts and where it ends. But seeing its contours as contours and as the contours of a deer implies that we have already identified it as a deer standing there, which is exactly where the enigma of what it takes to experience something in some contexts lies. On the one hand, in order to see something as something (the particular configuration in the woods as a deer, in this instance, and not as a truck or a UFO) we have to discern that something from its environment. But on the other hand, in order to discern it from its environment we have to see it as some particular thing, or in other words assign it a meaning. Structure presupposes meaning, and at the same time meaning presupposes structure. The two aspects, meaning and structure, are dialectically intertwined and occur simultaneously when we experience something.

Borrowing terminology from phenomenology, an internal and an external horizon of the structural aspects of experience can be discerned. The external horizon of an experience is the context that surrounds the phenomenon, including its contours. The internal horizon of experience is the parts and their relationships, together with the contours of the phenomenon. Marton and Booth continue their example (Marton & Booth, 1997, p. 87):

> Thus, the external horizon of coming on the deer in the woods extends from the immediate boundary of the experience—the dark forest against which the deer is discerned—through all other contexts in which related occurrences have been experienced (e.g., walks in the forest, deer in the zoo, nursery tales, reports of hunting incidents, etc.) The internal horizon comprises the deer itself, its parts, its stance, its structural presence.

This line of reasoning has developed into a theory of learning called variation theory (Marton and Pong, 2005; Runesson, 2005). It is a theory that defines learning in terms of changes in the way a phenomenon is seen, experienced or understood.

Variation theory focuses on the object of learning either as lived (what is actually learned), as intended (what the teacher wants students to learn) or as enacted (what is co-constituted in the interaction between students, or between students and teachers) (Runesson, 2005). The answer to the questions of what, come in the form of conceptions.

Learning can also be approached from other theoretical perspectives. For instance, it is not uncommon to use a individual constructivist perspective, inspired by Piaget's work, in which an active individual constructs his or her own understanding of the world. Education inspired by this perspective is often described in terms like 'active learning', 'discover things for yourself', 'experimentation', and 'being governed by your own curiosity' (Säljö, 2000). When the student engages in a situation the experience can either be assimilated as the expected, or it can create an accommodation where the current understanding of the world (cognitive schema) is changed to get equilibrium again. In the individual constructivist view, this change is where the learning takes place.

Another theoretical perspective on learning is the sociocultural, where learning is seen as an inherently social phenomenon. From an individual constructivist perspective, learning is based on a student's individual active engagement with the world and built on his or her own interests to create his or her own experience, without too much interference from teachers. From a sociocultural perspective, it is not likely, however, that students' self-governed activities give them the opportunity to discover abstract knowledge about the world. In a sociocultural theory, knowledge is not inherent in objects or events themselves, but rather in our discourse about them (Säljö, 2000). This makes communication and interaction among teachers and students, and among students central to the process of learning.

Runesson (2005) argues that learning can be approached using different theoretical frameworks that disclose different aspects of the complex phenomenon of learning. Whereas constructivism and sociocultural theories of learning focus on how students learn (the process of learning), either by the students' own activities in creating meaning, or by their interaction with each other and their teachers, variation theory focuses on what students learn (the object of learning). This means that variation theory is complementary to constructivist theories, which focus on individuals, and sociocultural theories, which focus more on interaction and discourse.

Central to variation theory is the notion that how people act is based on how they make sense of a phenomenon. To learn to manage a situation is therefore to develop an ability to see and understand the phenomenon in various ways. Students learn to distinguish different aspects of a phenomenon by being exposed to a variation of the phenomenon under study. They also need to learn where to direct their awareness and what to relegate to the background.

The teacher needs to highlight or emphasize the most relevant aspects of the phenomenon to facilitate learning. Variation theory stipulates that it is necessary to experience a pattern of variation to discern the critical characteristics of a phenomenon. This means that if a particular aspect is varied while others are kept constant, the varied aspects will be highlighted for the students, and it therefore facilitates learning.

To have competence in process quality in design means to be able to see and act effectively in a design process according to one's purposes and the conditions of the design situation. In the light of variation theory, this competence involves being able to differentiate among critical aspects and focus on these in the design situation. Such ability is developed by experiencing the variation in the phenomenon of process quality in design. Design educators need to expose students to a well-considered pattern of experienced variation. Variation in interaction design education could be imagined in several different dimensions. One important dimension to vary for interaction design education could, for example, be the development context: competitive bid contract development, off-the shelf product development, and in-house custom development (Grudin, 1991). Different development contexts create different possibilities and constraints for user participation that are important for a designer to learn.

The interview study aimed at identifying the variation of conceptions held by practicing interaction designers of process quality in design, in order to incorporate this when grading student projects.

4 Results

When analyzing the conceptions of process quality in design among interaction designers interviewed, two overarching themes emerged: strategic design work and operative design work. These themes are in fact conceptions of the interaction design work. The operative design forms the internal horizon of interaction design work, while the strategic design forms the external horizon. Again, the internal horizon refers to the elements and their relations that together form the constituents and the contours of the phenomenon experienced. In the example of the deer in the forest this would be the deer itself, its parts, its stance, and its structural presence. The external horizon refers to the context where the phenomenon is experienced. An example of that would be the dark forest against which the deer is discerned, as well as all other contexts in which related occurrences have been experienced.

4.1 Theme 1: Strategic Design

The referential aspects of strategic design reflect innovation and learning. Here, the term strategic implies that the designers have some control over resource allocation and objectives for the design work. Strategic design is about integrating design with business strategy. The structure of strategic design reveals two conceptions (A and B).

4.1.1 Conception A: The Design Process as an Inspirational Process

Ideally, the design process is inspirational to all stakeholders. The following excerpt from the interviews exemplifies this idea:

> We have done a bit more experimental things that awaken things in people's mind and they bring it home and do something. (Interview 2, Row 117)

One aspect of this conception is inspiring others' creativity. As seen in the short excerpt above, it is desirable that stakeholders are involved and take something with them from a design session or workshop and do something with it in their own practice. For the designer, this may involve a sketching session together with different stakeholders to ideate, confront, provoke and stimulate discussion. In this way, the designer can facilitate the creative process in others. In this conception, the design process becomes a process of participation.

Another aspect is that the design process becomes an eye-opener and an opportunity for reflection for stakeholders. This means that the design process enables them to perceive the situation differently and say, for example, "of

course, why didn't I think of that?" In order to reach such insights, the designer needs to experiment with new things in new environments. Visions may go beyond the immediately realizable, but they need to be thought-provoking and in some way break new ground or offer a novel point-of-view.

4.1.2 Conception B: The Design Process as a Thought-Through Rationale

A good design process allows the designers to think things through, to understand the design situation, and feel that they can stand up for the design proposals. They need to be able to present the arguments for the design solution (i.e. express the design rationale). The following excerpt from the interviews exemplifies this conception:

> Creating knowledge, I mean, that aspect of design. To explore and express. To like, really feel that I haven't only made a drawing of your list of functions that you want, but I have, I have explored what the list of functions come out of. I have understood the list of functions and I have maybe even added or removed something from this requirement specification. Can't sort of take that for granted. It isn't an axiom what the client says, but rather, I have understood what the customer means, and here is what the end-user needs. And here we have the result of my process. (Interview 4, Row 358)

In interaction design, thinking things through involves envisioning sequences of interactions, screens, or states. It involves thinking through why something is a problem to someone, i.e. understanding purposes and motivations. It involves how to approach the problem in depth. It is also about working with alternatives, in breadth, both on a holistic and a conceptual level, and also on the level of detailed interaction. Only when a designer has explored in breadth and depth can he or she make informed, conscious design judgments and decisions based on facts. Being rational also means contextualizing the design and working through any possible problem that comes with the design, to make it sustainable and durable over time, both technically and contextually.

This conception is also about learning. People who are involved in a project go through experiences and learn from them. The designer expresses his or her own understanding of and point-of-view on the problem. In order to do this, he or she needs to really probe the constraints and possibilities, explore the problem and what lies behind it, and make a design solution as good as possible, and not just good enough.

Design work is about being a strategic discussion partner for the client's business. Without business, there is no design work. This is central to the client perspective for design consultants. However, equally central is the user perspective, which means taking users' goals, needs, and ways of working as the starting point for the design effort. The perspectives of multiple actors and stakeholders need to be balanced and understood thoroughly.

This conception of the design process boils down to giving a solid argument for the design, that is, a complete, unfragmented reasoning behind the design.

4.2 Theme 2: Operative Design

The referential aspects of operative design reflect the operational design work and technical performance of the day-to-day activities of the design project, and simply getting the job done. The structure of operative design also reveals two conceptions (C and D).

4.2.1 Conception C: The Design Process as Application of Established Methods

There are many design methods, and one part of design education is to teach these methods. Some methods are shared among design disciplines and some are typical of a specific design discipline. In interaction design, there is a focus on user-centered design and participatory design, using methods and techniques like personas, scenarios, storyboards, paper prototypes, interactive computer prototypes, and usability testing. The following excerpt from the interviews exemplifies this conception:

> I can feel that what I have learned during my education is more of a way to work that can lead me to good design, not perhaps what good design is. (Interview 6, Row 291)

In this view of the design process, there is an emphasis on being methodical, to at least reach the decided design objectives, and also on research work in cooperation with users, clients, and other designers to identify and conform to users' needs and ways of working. Accordingly, the process is goal-oriented and user-oriented, and it is preferably managed by using measurable goals. The participants in the interviews also highlight the importance of the quick iterations and visualization in idea sketching, the openness to inspiration from unexpected sources, and parallel design with multiple alternatives.

4.2.2 Conception D: The Design Process as Managing within Constraints

It is one thing to have high ideals, and another thing to manage all the constraints you have in real-life working design projects. The following excerpt from the interviews exemplifies this conception:

> Yeah, but this is good you know, this is good enough, I'm proud of what I've done. And then you weigh in that some things have been difficult to get implemented the way you've imagined or like organizational difficulties. (Interview 3, Row 7)

The constraints include the brief that functions as input to the design process, as well as the things that the designers feel are outside their focus and beyond their control.

Sometimes it is necessary to be satisfied with just doing the job well enough, as long the objectives stated in the design brief are fulfilled. There may be a tight time frame to work within, difficulties in the client organization, or unexpected technical difficulties. The design process as managing within the constraints comes down to balancing ambition and budget; i.e. what you would like to do versus what you can do.

4.3 Summary of Referential and Structural Aspects of the Conceptions

Table 1 summarizes the referential and structural aspects of the four conceptions of process quality in design identified in the interviews.

Table 1. Conceptions of process quality in interaction design

Conception	Referential aspect	Structural aspect
A	Design process as being inspirational for project participants	Focused on stakeholders who participate creatively, and are provoked into seeing things differently
B	Design process as reflecting a thought-through rationale behind the designed artifact	Focused on the design decisions and the motivations for them, based on an exploration of alternatives in breadth and depth, in relation to their appropriateness for users and businesses
C	Design process as applying established methods in the project	Focused on professionally conducted activities in the project, such as user research, setting objectives, idea sketching, openness to inspiration, and parallel design
D	Design process as managing within the constraints on the project	Focused on the objectives stated in the brief, the resources, and the organizational and technological limitations of the project

Table 1 shows how process quality in design is demarcated by the project in focus for the practicing interaction designers. The day-to-day work with the project makes up the internal horizon of the experience together with all the activities, objects and constraints of which the project consists. The strategic and longer-term considerations for the project in terms of participation, changing how people think, and design rationale make up the external horizon of process quality in design for practicing interaction designers.

4.4 Developing Assessment Criteria

Table 2 maps the conceptions to a grading scale where 3 is good, 4 is very good, and 5 is excellent. Each conception is associated with a set of assessment criteria. These criteria reflect the structural aspects of the conceptions.

Getting the job done and following procedures is what defines the operative level of design work. This forms a baseline for what can be expected from a design process. The strategic design works presupposes well-performed operative design work. It functions as a meta-level of the process of getting the job done.

We can therefore see a hierarchical relationship between strategic design work and operative design work, where the design process has to be performed well, at least at the operative level, which means that it gives evidence of meeting the criteria for employing established methods and managing within the constraints. This can then correspond to the passing grade, or grade 3 in a five-point scale.

Table 2. The structural aspects of the conceptions used as assessment criteria for grade 3 to 5

Conception	**Grade**	**Assessment criteria**
A	5	Inspiring others' creativity Thought provoking
B	4	Exploring alternatives in breadth and depth Motivating judgments and decisions Probing constraints and possibilities Balancing the perspectives of multiple actors
C	3	Methodical Goal and user-oriented Idea sketching
D	3	Good enough Fulfills stated objectives

The very good grade, or 4 on a five-point scale, is awarded to design projects that in addition to criteria for employment of established methods and managing within constraints also give evidence of meeting the criteria for a thought-through rationale.

The excellent grade, or 5 on a five-point scale, can be reserved for design processes that, in addition to the other criteria, also give evidence of meeting the criteria for an inspiring design process.

It would also be possible to make a distinction between a plus and a minus on each grade (e.g. 3+ and 3-). The plus could be awarded to design projects that indicate a process that has been very well performed with regard to several of the criteria for that grade. The distinction between the well performed and the very well performed, however, is not clear-cut. The minus could be given to design projects that show a process that is not well performed with respect to one or two of the criteria.

4.5 Testing the Assessment Criteria

To be able to use the general criteria as grounds for grading in a specific course, these need to be specified further. The course specific criteria also need to be understandable to both the students and the teachers who do the grading.

The criteria were developed and tested in a project for teachers and students in an interaction design course for students in graphic design and communication. The learning objectives for the course were that after completing the course the students should be able to:

- Conduct an interaction design process with a user perspective.
- Plan and describe a design process.
- Give an account of concepts, perspectives, processes, techniques, and methods used to solve tasks and problems in the design work.
- Critically discuss each others' design methods and design solutions.

The final learning objective was not examined as part of the project work. It was examined as a separate written critique of another project group's report. The learning objectives in the course plan give the examining teacher guidance on what is needed in terms of student performance on the basic level (grade 3, passing level), but they do not give guidance for grade 4 (very good performance) and 5 (excellent performance).

Two design briefs were given to the students, and they were to choose one of them to work with on their project. One brief was to develop proposals for how printed electronics can be used together with other terminals and systems like scanners, mobile phones, screens, information kiosks, digital tables, websites, cash machines, storage systems, and logistical systems in stores. They were asked to define their objective themselves. This could, for example, be to improve the customer experience of a store visit, improve employee health and safety, sell more, increase efficiency, or increase safety.

The other brief was to design a web site in which students could submit assignments, comment on others' submissions, and respond to comments. Teachers should also be able to provide feedback and grades on submitted assignments, but also internally within the teacher group, be able to discuss details. It should also be possible to select specific parts of the submission and comment on those specifically. Meanwhile, a portfolio (a public portion of the student's work) would be automatically generated. Students could show the portfolio to potential employers, but other students could also be potential users. It should also be possible to edit and personalize the portfolio.

The students' design processes were to follow a goal-directed design process as outlined by Cooper et al. (2007), which included planning, user research, modeling of personas, scenarios, and requirements, framework design including storyboarding, and the refinement and testing of a paper prototype.

We chose to examine the students' work by means of written reports rather than design logs, to give them training in report writing. This included supplying them with a guide to writing reports. The report was assessed according to academic criteria such as correct use of concepts, methods and theories. The rest of the criteria were specifications of the general criteria identified in the qualitative content analysis of how practicing interaction designers conceptualize process quality in design.

Table 3 shows the course specific criteria and the corresponding general criteria from the interview study.

Table 3. Course specific criteria for each grade level, and corresponding general criteria

Grade	Course specific criteria that the report should meet	General criteria that the specific criteria evaluate
3	a. The design solution is appropriate in relation to the design problem in the brief.	Fulfills stated objective, Good enough
	b. User studies have been conducting in accordance with assigned literature.	Goal and user-oriented, Methodical
	c. Personas, scenarios, and requirements have been developed in accordance with the assigned literature.	Goal and user-oriented, Methodical
	d. The framework design has been developed in accordance with the assigned literature.	Idea sketching, Goal and user-oriented, Methodical
	e. Detailed design and prototype has been developed in accordance with the assigned literature.	Idea sketching, Goal and user-oriented, Methodical
	f. User testing has been conducted in accordance with the assigned literature.	Goal and user-oriented, Methodical

	g. Concepts, methods, and principles from the course literature have been used in a correct way.	Academic criteria
4	a. Design alternatives have been developed in sketches.	Idea sketching, Exploring alternatives
	b. Design alternatives have been assessed using plus-minus lists.	Motivating decisions
	c. Design decisions are explicitly made based on the assessment of alternatives.	Motivating decisions
	d. Reasoning behind the design is well thought out.	Motivating decisions
	e. An understanding of different stakeholder perspectives and underlying needs has been developed.	Balancing actors, Probing constraints
5	a. The assigned literature is used to analyze the work in an informed way.	Academic criteria
	b. The design work is inspirational to others.	Inspiring others' creativity
	c. The design work opens your eyes to a new way of looking at the design problem.	Thought provoking

Table 4 shows that most students understood the course specific criteria quite well or very well (the median was 3 to 4 for all criteria).

Table 4. The degree of comprehension (median, med) and dispersion of comprehension (quartile deviation, QD) for the course specific criteria (referring to the criteria in Table 2)

Criterion	**Med**	**QD**
3.a	4	0.5
3.b	4	0.5
3.c	4	0
3.d	3	0.5
3.e	3.5	0.5
3.f	4	0.5
3.g	3	0.7
4.a	4	0.5
4.b	4	0.5
4.c	3	0.5
4.d	3	0.5
4.e	3	0.5
5.a	3	0
5.b	4	0.5
5.c	3.5	0.5

The dispersion was largest on the academic criterion “Concepts, methods, and principles from the course literature have been used in a correct way” (median = 3, QD = 0,7). This suggests that this criterion was problematic for many of the participants. It was therefore explained in more detail to the students in the following way:

> There are many terms, methods and principles described in the books and articles. For the grade 3, there should be no misunderstandings about what they mean. When you read the report, one soon recognizes whether or not the authors understand what they have read.

The five remaining criteria that were understood quite well (median = 3) had a quartile deviation of 0.5. This means that there were some participants that did not understand the criteria very well.

The two teachers had a significant and strong covariation (Spearman's rho = .99, $p < .001$, two sided). The teachers also had a high level of agreement between them (Cohen’s kappa = .89). It took half an hour to mark and comment one project report for the more experienced teacher, and one hour for the more inexperienced teacher.

No student group was given the highest grade, since no group had used all the assigned course literature to analyze their work. This meant that they did not fulfill the academic criteria referring to analytical distinction. However, they fulfilled the process quality criteria developed based on the identified conceptions. Many students also reported that they thought that writing the report took too much time from the actual design work. Both teachers agreed that if the students had used all the assigned literature, or if grading had been based on the design work alone, three of the groups would have been given the highest grade.

One of the teachers also found two of the three criteria for the highest grade difficult to apply. This calls for a revision of the criteria for the highest grade.

5 Discussion

The assessment criteria for the design process developed in this study can be compared to the earlier application of SOLO in design (Leung, 2000). We can then see some similarities for the two higher grades (4 and 5), but a difference for the passing grade (3, denoting good performance), which in our scale, is more pragmatic. The passing grade is simply about getting the job done. This may be a reflection of the practitioners’ values used to generate the criteria, rather than to the academic values used to generate the design adaptation of SOLO.

5.1 Comprehension and Reliability

The two teachers had a significant and high covariation and agreement in their grading (Spearman's rho = .99, $p < .001$, two sided, and Cohen's kappa = .89). This means that the criteria developed were reliably applied. In other words, the grades assigned were not only the results of one teacher's subjective judgment, and two teachers could have divided the grading task for practical purposes. It could, however, still be a good idea to raise borderline cases up for discussion among the teachers of a course, to further reduce the risk of idiosyncratic results.

Leung (2000) reported a correlation of 0.49 between teachers using his design adaptation of the SOLO taxonomy, but without specifying the type of reliability coefficient or statistical method. No significance tests are reported. Leung considered the correlation acceptable, but not satisfactory for a first attempt at using the taxonomy.

We noted that some of the graphic design and communication students had difficulty understanding the academic criteria. This called for further explanation by the examiner. Still, no groups met the academic criteria for the highest grade (these criteria were the same as in earlier years, but the design criteria had been changed). A response to this issue could be to provide the students with excerpts from an example report, and highlight how the literature is used to analyze the design work.

The response rate to the questionnaire for how well the students understood the criteria was 60%. Most of the students at the lecture where the questionnaire was handed out also answered it. It is quite possible that these students also attended many of the other non-mandatory lectures for the course. The lectures are likely to give a rather good picture of what the lecturer means with regard to the grading criteria. This means that there may be a bias in the results so that the comprehension of the criteria is skewed higher. A cautious interpretation is therefore that most of the students who attended the lectures also understood the criteria. Some of them, however, did not understand them very well.

5.2 Revision of the Criteria for the Highest Grade

There are still problems with the criteria for the highest grade, even though a majority of the students thought that they understood them, and there was high agreement and correlation between the teachers. The main problem was that the junior teacher found the criteria difficult to apply. It is difficult to decide whether or not a design process is inspiring and an eye-opener. The main problem behind these criteria is that the baseline for judging originality is subjective. The experienced teacher in our study had seen more student design work and was comfortable in making this judgment, while the junior

teacher had more difficulties. Another problem is that the students cannot be expected to be experienced enough to know or be able to judge the originality of their own design work. This means that in reality they cannot understand these criteria.

It is clear that a revision is needed and the history of interaction design can actually provide us with some hints on how to make this revision. The criteria for the highest grade are in fact not necessary and can be omitted for a basic-level interaction design course. Instead they can be introduced in later courses during the students' third year or even at master's level. An entire course at an advanced level could be devoted to Conception A, "The Design Process as an Inspirational Process". This would then mean that Conception B, "The Design Process as a Thought-Through Rationale" would be used both for grades 4 and 5 in the course at the basic level. The structural aspect of Conception B has two parts: (1) considering the perspectives of multiple user stakeholders and business stakeholders, and (2) divergent exploration of the design space in depth and breadth. If the students do one of these, they could be given grade 4 and if they do both they could be given grade 5. Yet another option would be to split the grades on the basis of the two conceptions of the operative design. The best choice would then depend on the desired learning outcomes and on the progression between courses in a study program (see Section 5.4).

5.3 Interaction Design Traditions

Looking back on the history of interaction design, one can see that connections to several traditions are expressed as ideals in the conceptions of what constitutes process quality in interaction design. The conception of the interaction design process as inspiring others to participate and encourage their creativity is clearly connected to participatory design (Schuler and Namioka, 1993). The conception of the process as thought provoking is related to critical and reflective design (Gaver and Martin, 2000; Löwgren and Stolterman, 2005; Sengers et al., 2005). Being able to give a thought-through rationale can be firmly rooted in the ideas and methods of design rationale (MacLean et al., 1989). Finally, the conception of established methods is the focus of the most commonly used textbooks on interaction design (Cooper et al., 2007; Sharp et al., 2007; Benyon, 2010; Saffer, 2010).

The connection between the criterion of inspiring others' creativity and the tradition of participatory design also suggests a solution to the problem of how to assess a design process on that criterion. An operational and readily examinable criterion for design that is inspiring for others' creativity could simply be whether the students use methods from the participatory design tradition.

The same line of reasoning may be applied to the criterion of thought-provoking design, i.e. that a more operational criterion could be whether the students use theories and methods from the critical design tradition.

5.4 Progression

If we are to take variation theory (Marton and Pong, 2005) seriously, we may use the conceptions identified to not only define grading, but also to devise a variation in the students' learning experiences. This may be done within a course, but also across courses. If, within one curriculum, there are several courses that focus on process rather than product, one might establish a progression using the grading scale presented here. The requirements for a passing grade in a basic design course may not be enough in the follow-up course. At advanced or graduate level, the student may have to be able to present a thought-through rationale or even an inspiring design process to pass the course.

It was found that the criteria for the highest grade were difficult for the junior teacher to apply, and also may not be fully understood by undergraduate students. A possible solution is to leave out those criteria, and instead develop course specific grading criteria based on the remaining general criteria. This would mean that for grade 4 the students have to fulfill two or more of the criteria of a thought-through rationale, and all of them for grade 5. Inspiring others' creativity and thought-provoking design would then come back as a specific topic at the advanced and graduate level, with a full course on participatory and critical design.

Another option at the advanced and graduate level is to use more academic criteria, with focus on analysis or research to achieve the higher grades. Yet another way to define progression is to develop a wider range of methods. This means that there are several different ways to set up the progression between design courses, and it remains unclear which path is the right one to choose.

5.5 Generalization

The grading criteria are most likely applicable in other process-centered interaction design courses. However, another question is how applicable these grading criteria are for other design disciplines outside interaction design (e.g. product design). They are likely to be applicable to a large extent, but it would be necessary to replace the methods, and perhaps more focus should be placed on ergonomics than on usability.

Eight of the ten participants in the interview study had an educational background in cognitive science with a focus on interaction design, and this may cause a bias. It is likely that participants with a background from an art

and design school would have yielded a different result. Based on this study it is difficult to speculate what the result would have been, and further research would be necessary to answer that question.

The general criteria derived from the interview study with practicing interaction designers can be specified in course specific criteria in many different ways. In this study we have tested one instance in one of our courses, and concluded that there were both strengths and weaknesses in the way in which we had used the general criteria. In this particular case, this will give rise to a revised set of course specific grading criteria in next year's course, but the course will still be based on the same set of general criteria. The same kind of careful implementation of the criteria needs to be made every time they are used in a specific course.

A translation to the ECTS (European Credit Transfer and Accumulation System) is used centrally at our university is 3 = C, 4 = B, and 5 = A, but different Swedish universities convert grades differently. The ECTS grading scale is relative rather than criterion-referenced, which makes the translation approximate. It is necessary to make some adaptations to use the developed criteria in a relative grading scale. One such adaptation would be to award points depending on the level of achievement and then rank the projects from the points awarded in order to determine the grades.

One of the teachers involved in the grading also developed the grading criteria, while the other teacher only was introduced to them. Despite this difference, there was a high degree of correlation and agreement between the teachers. A better case for the use of the criteria would, however, have been if the teachers had not been involved in the creation of the criteria at all. A recommendation based on this weakness in the study is that the teaching staff spends some time discussing the meaning of the criteria and how they should be adapted to the current course.

5.6 Future Research

In this paper, we have investigated how interaction designers reason about design processes, but eight of the ten participants had an educational background in cognitive science. It would be interesting and worthwhile to explore how interaction designers with other backgrounds reason about the same issues. The participating designers also had four to thirteen years of experience, which means that they were mid-career. This is a point at which you often shift from an operative focus to a more strategic focus. It would be interesting to investigate further how the conceptions of process quality in design differ at different stages of the career. The participants also worked at small companies, but medium sized companies would be expected to have a human resource department with some kind of competency models (articulated or implicit) used to define job roles and guide recruitments. What

these models are and how they are used in relation to interaction design is another topic for future research.

This study has focused on lecturers as assessors of the design work. The role of practitioners as assessors, as well as self-assessment and peer-assessment may also be explored. This topic deserves a separate study.

The issue of how to assess and judge the originality of students' design work remains an open issue, and future research on this issue would be very welcome.

Another unresolved issue is how to set up the progression between design courses in a curriculum. Several ideas have been suggested in this paper, but which one should be chosen depends on contextual factors. This issue also deserves a separate study.

6 Conclusions

In conclusion, this paper has provided assessment criteria grounded in professional practice for grading an interaction design process, documented in a design log or project report. Practicing interaction designers see the criteria for process quality in design as: Inspiration, a thought-through rationale, employment of established methods, and managing within constraints. These general criteria were specified in a particular design course and evaluated. The general criteria should be generalizable to other process-centered interaction design courses, and with careful transfer, also to other design disciplines. However, specific attention to comprehensibility of the criteria is required when developing course specific grading criteria.

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